

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents **jc685 U.S. PTO**
 Washington, D.C. 20231

Atty Dkt.: **922-81**

Sir:

Attached for filing is the patent application of:

Date: **January 31, 2000**

Inventor: **Christopher J. BUSE et al**

Entitled: **ALLOCATION OF IP ADDRESS BY PROXY TO
 DEVICE IN A LOCAL AREA NETWORK**

and including attachments as noted below:

- ☒ Declaration, ☒ Abstract
 7 pages of specification and claims (including 6 numbered claims), and
 3 sheets of accompanying drawing/s.
☒ Record & return the attached assignment to the undersigned.
☒ Priority is hereby claimed under 35 USC 119 based on the following foreign applications, the entire content of which is hereby incorporated by reference in this application:

Application Number

Country

Day/Month/Year Filed

9925897.2

Great Britain

3 November 1999

, respectively.

- ☒ Certified copy(ies) of foreign application(s) is/are attached..
☐ Please amend the specification by inserting before the first line --This is a _____ of PCT application _____, filed _____, the entire content of which is hereby incorporated by reference in this application.--
☐ Priority is hereby claimed under 35 USC 120/365 based on the following prior PCT applications designating the U.S., the entire content of which is hereby incorporated by reference in this application:

Application Number

Country

Day/Month/Year Filed

This application is based on the following prior provisional application(s):

Application No.

Filing Date

respectively, the entire content of which is hereby incorporated by reference in this application, and priority is hereby claimed therefrom.

Please amend the specification by inserting before the first line: -- This application claims the benefit of U.S. Provisional Application No. _____, filed _____, the entire content of which is hereby incorporated by reference in this application.

Verified Statement attached establishing "small entity" status (Rules 9 & 27)

The Examiner's attention is directed to the prior art cited in the parent application by applicant and/or Examiner for the reasons stated therein.

Preliminary amendment to claims (attached hereto), to be entered before calculation of the fee below.

Also attached:

FILING FEE IS BASED ON CLAIMS AS FILED LESS ANY HEREWITH CANCELED

Basic Filing Fee		\$	690.00
Total effective claims	6 - 20 (at least 20) = 0 x \$ 18.00	\$	0.00
Independent claims	2 - 3 (at least 3) = 0 x \$ 78.00	\$	0.00
If any proper multiple dependent claims now added for first time, add \$260.00 (ignore improper)		\$	0.00
	SUBTOTAL	\$	690.00
If "small entity," then enter half (1/2) of subtotal and subtract		-(0.00)
	SECOND SUBTOTAL	\$	690.00
Assignment Recording Fee (\$40.00)		\$	40.00
	TOTAL FEE ENCLOSED	\$	730.00

Any future submission requiring an extension of time is hereby stated to include a petition for such time extension.

The Commissioner is hereby authorized to charge any deficiency in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our **Account No. 14-1140**. A duplicate copy of this sheet is attached.

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Our Ref.: 922-81
105135

U.S. PATENT APPLICATION

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Invention: ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL
AREA NETWORK

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SPECIFICATION

Attorney Docket:

APPLICATION

FOR

UNITED STATES LETTERS PATENT

Be it known that we, Christopher John Buse, a citizen of Great Britain, residing at 126 Balmoral Road, Watford, Hertfordshire, WD2 4ET, England, Andrew Peter White, a citizen of Great Britain, residing at 6 Westbourne Mews, The Maltings, St Albans, Hertfordshire, AL1 1LS, England, David Kirby, a citizen of Great Britain, residing at 40 Kimpton Close, Hemel Hempstead, Hertfordshire, HP2 7PW, England, Robert Allsworth, a citizen of Great Britain, residing at 5 Soden Place, The Paddocks, Faringdon Road, Abingdon, Oxfordshire, OX13 5EY, England and David Eric Bill, a citizen of Great Britain, residing at 14 Beresford Road, St Albans, Hertfordshire, AL1 5NP, England have invented new and useful improvements in:

ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL AREA NETWORK

of which the following is a specification:

ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL AREA NETWORK

Field of the Invention

This invention relates to packet-based data communication networks, particularly local area networks (LANs) and more particularly to the allocation of a protocol (IP) address to a device newly connected into the network.

Background to the Invention

When a new device is connected into an existing network, typically a local area network, it is desirable to determine whether such a device has a protocol address which is compatible with other devices on the network and to allocate the protocol address to the device if it does not already possess one. Another aspect of the process is the discovery of a device which does not have a protocol address on a network and to configure its protocol address in a convenient and compatible manner.

There are various schemes, such as dynamic host communication protocol (DHCP), and automatic private IP addressing, which can be used by a device to obtain a protocol address which is compatible with the network in which the device is to operate.

Ordinary network management discovery mechanisms generally rely on an existing configuration of devices for IP (internet protocol) and discover devices by performing a process known as ICMP Echo Request and Reply for all the IP addresses in a management station subnet. They presume that the user or network manager is knowledgeable.

Many devices have limited memory available for embedded software and are therefore not well adapted for direct participation in the programmed allocation of IP addresses.

Summary of the Invention

One aspect of the present invention is a discovery scheme which can be operated by a proxy device, such as a personal computer coupled to a local area network, and which facilitates the discovery of devices which may or may not be configured with an IP address

Another aspect of the invention is a proxy scheme for the allocation of an IP address to a new unconfigured device discovered by the discovery mechanism.

Further objects and features will be apparent from the following description by way of example of a preferred scheme according to the invention.

Brief Description of the Drawings

Figure 1 illustrates in simplified form a local area network and some devices connected thereto.

Figure 2 schematically illustrates a discovery protocol.

Figure 3 illustrates the operation of an IP address allocation scheme which may be performed by a proxy in a system according to Figure 1.

Figure 4 is a table showing the organisation and sizes of fields within control packets which may be employed in the present invention.

Figure 5 is a table indicating the names and purposes of the fields within the control packets.

Figure 1 illustrates a local area network 1, comprising a multiplicity of interconnected devices. Coupled to the network is a user terminal 2 which may, particularly if it is operating under a 'Windows' (registered trade mark) operating scheme, host a DHCP

(dynamic host communication protocol) and also an automatic private IP addressing scheme. Reference numeral 3 denotes a PC coupled to the local area network and capable of operating the schemes described hereinafter.

5 Various allocation schemes may be used in networks of this general character. They are known as DHCP, automatic private IP addressing and the manual allocation of static addresses.

10 PCs that are configured to acquire an address by DHCP but fail to locate a DHCP server may be able to allocate themselves an address at pseudo random from a particular subnet. If the PC supports DHCP but not the self allocation feature it will attempt to operate with no IP address if DHCP fails to allocate an address. In this instance the PC will operate as a local machine but not participate in the network. If the PC can allocate its IP address it then performs an address resolution protocol on the address to check for any conflict and proceeds to use the allocated address.

15 Figure 2 illustrates the discovery protocol which may be performed by the proxy in relation to a new device. Figure 3 and 4 illustrate by way of example the control frames or packets that can be employed. The process employs three basic packets, distinguished by different operating codes ('Op-codes'). The proxy will periodically send an interrogation, identified herein as a frame having the 'ARE_YOU_THERE?' op-code. Devices that see such an interrogation will respond with a reply, identified herein as a control frame having the 'I_AM_HERE' op-code. The device will return its MAC address (the third, 6-byte, field shown in Figures 4 and 5. Unconfigured devices will respond with an IP address field set to a conventionally invalid value such a 0.0.0.0. Devices such as servers that have previously been configured will respond with an IP address field set to their IP address, completing the exchange. If desired or appropriate the device may return in the appropriate fields values for a subnet mask (set to an invalid value if the device is unconfigured), a default gateway (likewise set to an invalid value if the device is unconfigured) and a lease time which can be used by a proxy to indicate that the address is obtained by DHCP and is time-limited. A particular conventional value is employed to represent an infinite lease time.

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A response from a device with an unconfigured IP address will initiate a process for resolving an IP address. That process is described with reference to Figure 3 and in practice is mainly performed by software within the proxy 3.

When the proxy has resolved an IP address for the device it sends a declaratory message, identified herein as 'YOU_ARE' the message including the allocated IP address and preferably a subnet mask and other IP configuration parameters

Upon receipt of the 'YOU_ARE' message frame the device will configure itself with the supplied parameters and respond with a 'I_AM_HERE' message frame, the IP address field being set to the new IP address allocated to that device. If the allocation mechanism were through DHCP, the device will use that IP address for as long as its lease time allows. It will revert to 0.0.0.0 when the 'lease' expires. Periodically, the proxy may update (or validate) the least be interaction with the DHCP server to gain refreshed lease parameters. A special case of the lease is 'infinite' where the IP address is used for as long as the device is operational

As will be apparent, an advantage of such a scheme is that the functionality associated with operating an IP address allocation scheme such as DHCP can be migrated from the device to a proxy. In practice, this means that the device need only (for the purpose of address allocation) contain 'embedded' software sufficient to respond to the messages described previously. This requires minimal storage space in the device. New IP schemes require only an upgrade to an application which runs on the PC and will not normally require an upgrade of the devices. Furthermore, the scheme will operate over networks. It can be used to hide the MAC address from the user. The MAC address is used by the proxy to uniquely identify a device so that the device is not confused with other devices. If an IP address needs (as described later) to be entered by the user, the user is prompted to supply merely an IP address; there is no need to specify the MAC address because this is handled internally by the proxy.

Figure 3 illustrates a scheme by which the IP address may be allocated to an unconfigured device newly discovered on the network: The stages shown in Figure 3 are all performed by the proxy device 3 on behalf of the 'new' device 4.

5 Stage 31 indicates the discovery of a new unconfigured device. This corresponds to the receipt of the 'I_AM_HERE' message with the dummy IP address as described with reference to Figure 2. The proxy 3 now sends a DHCP request on behalf of the device 4. If there is a DHCP server on the network, the proxy 3 will receive a DHCP response with an IP address for the device. The proxy can then send out a YOU_ARE frame configuring
10 the device 4 with this IP address – stage 34. If the proxy does not receive a response to the DHCP request then it will timeout and move on to stage 35. If there is a time-out, there is a determination whether proxy's address is in the automatic private IP range. For the proxy to allocate IP addresses to devices using Automatic Private IP addressing, its own address must also be in this range. If its address is not in this range and the device is allocated an IP address from the auto IP range then the proxy will not be able to
15 communicate with the device using IP as they will be in separate subnets. If it is in that range, an IP address may be automatically allocated, stage 36, the address may be tested for conflict with any existing addresses (stage 37). This may be done by means of an address resolution protocol (ARP) or an ICMP echo request. If there is a conflict, i.e. with an existing occupied address (stage 38) this sub process (stages 36 – 38) is repeated.
20 Every time stage 36 is entered a new address is generated from the auto IP range for testing in stage 37. This cycle will continue until a free address is found. These three stages are all defined by an automatic private IP addressing scheme. If the proxy's address is not in an automatic private IP range, the user is prompted to provide an IP address, stage
25 39. On entry of the address the proxy checks whether the address is on the same subnet (stage 40). If necessary the manually entered IP address is conveyed to the device, stage 34.

Claims

1 A method of allocating a protocol address to a device connected to a packet-based communication network, comprising

placing on the network an interrogation in the form of a first control frame from a proxy;

receiving at the proxy a response in the form of a second control frame which defines an invalid protocol address for said device; and

sending from the proxy to said device a third control frame which includes a protocol address allocated to said device

2. A method according to claim 1 and further comprising:

in response to the reception of said second control frame by said proxy, operating said proxy to test potential protocol addresses for conflict with existing protocol addresses, and obtaining said protocol address when conflict thereof with existing addresses is absent.

3. A method according to claim 2 and further comprising operating said proxy to obtain a protocol address for said device by any one of steps (a) to (c) as follows:

(a) by means of a request addressed according to a dynamic host communication protocol,

(b) automatic private IP addressing; and

(c) manual entry of the protocol address.

4. A method according to claim 3 wherein said steps (a) to (c) are performed in the order (a), (b) and (c) until the protocol address is obtained.

5 A method of allocating a protocol address to a device connected to a packet-based communication network, comprising:

placing on the network an interrogation in the form of a first control frame from a proxy;

receiving at the proxy a response in the form of a second control frame which defines an invalid protocol address for said device; and

in response to the reception of said second control frame by said proxy, operating said proxy to test potential protocol addresses for conflict with existing protocol addresses,

obtaining a protocol address when conflict thereof with existing addresses is absent; and

sending from the proxy to said device a third control frame which includes a protocol address allocated to said device.

6. A method according to claim 5 and further comprising operating said proxy to obtain said protocol address for said device by the steps of:

(a) addressing a request according to a dynamic host communication protocol;

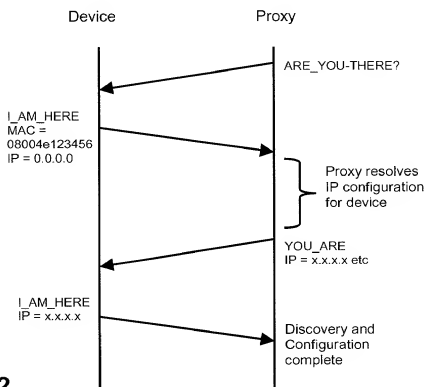
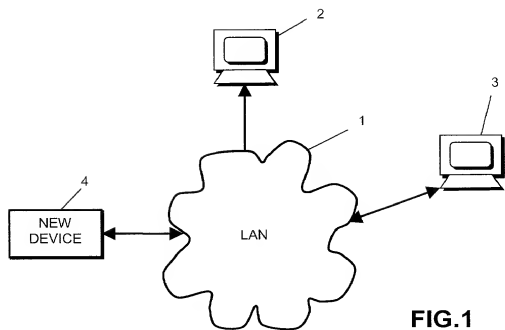
(b) in the absence of obtaining said protocol address by step (a), automatic private IP addressing; and

(c) in the absence of obtaining said protocol address by steps (a) and (b), manual entry of the protocol address.

Abstract

5 A device is discovered on a network by means of a discovery protocol operated by a proxy and a protocol address for the device is obtained if required by the proxy, which requests a protocol address in accordance with a dynamic host communication protocol, then in the absence of response to that request attempts automatic private addressing and
10 finally if necessary allows manual entry of a protocol address for the device.

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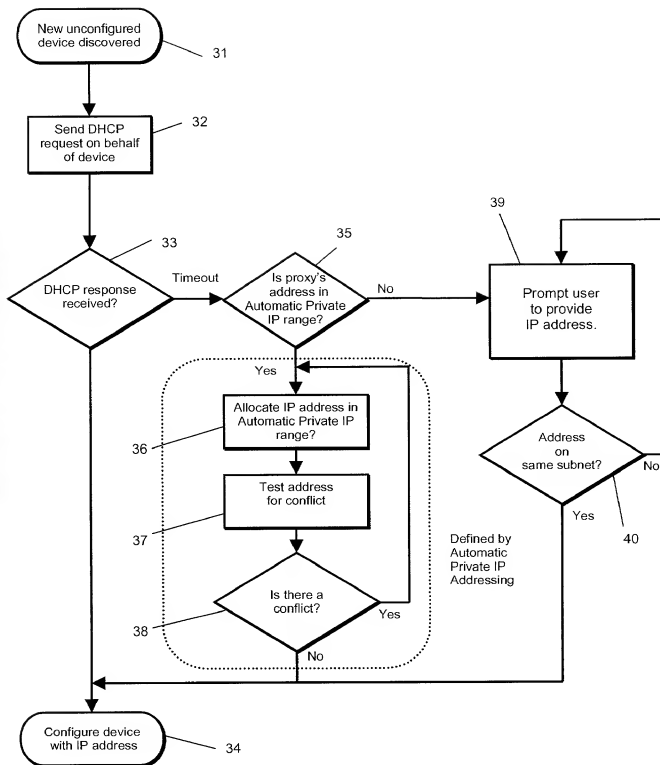


FIG.3

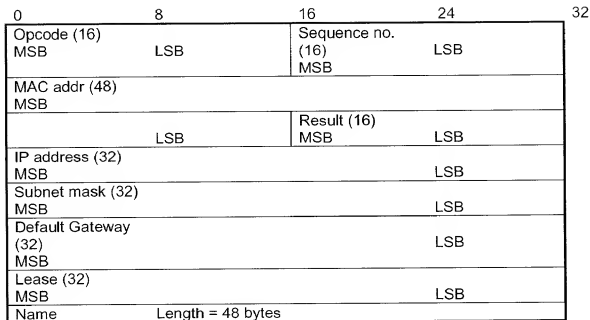


FIG.4

Field	Size(bytes)	Description
Op-code	2	1 = I_AM_HERE (sent by device, includes current units parameters) 2 = YOU_ARE (sent by proxy, includes parameters to use) 3 = ARE_YOU_THERE (sent by proxy, parameters ignored)
Sequence Number	2	Sequence Number. Will be set to a new value for each request, used to match requests with responses.
Mac Address	6	Unit hardware address or broadcast address for an initial ARE_YOU request frame
Result	2	0 = No error
IP Address	4	Unit configured IP address (0.0.0.0 if unconfigured)
Subnet Mask	4	Unit configured Subnet mask (0.0.0.0 if unconfigured)
Gateway	4	Unit configured default gateway (0.0.0.0 if unconfigured)
Lease	4	The length of time in seconds for device to use these IP address parameters. This is used by proxy to indicate that the address is obtained via DHCP and has a finite lease time. 0xFFFFFFFF represents a non-expiring address.
Name	48	ASCII string with the description of the unit (e.g. 3Com OfficeConnect Dual Speed Switch 16). Padded with 0's, unless maximum length.

FIG.5

**RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL AREA NETWORK

the specification of which (check applicable box(es)):

☐ is attached hereto
☐ was filed on _____ as U.S. Application Serial No. _____ (Atty Dkt. No. _____)
☐ was filed as PCT International application No. _____ on _____
and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application.

Priority Foreign Application(s):

Application Number 9925897.2	Country Great Britain	Day/Month/Year Filed 3 November 1999
--	--------------------------	--

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below



Application Number	Date/Month/Year Filed
--------------------	-----------------------

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below and, insofar as the subject matter of each of the claims of this application is not disclosed in such prior applications in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior applications and the national or PCT international filing date of this application.

Prior U.S./PCT Application(s):

Application Serial No.	Day/Month/Year Filed	Status: patented pending, abandoned
------------------------	----------------------	--

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby appoint **NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000** (to whom all communications are to be directed), and the following attorneys thereof (of the same address) individually and collectively owner's/owners' attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent: Arthur R. Crawford, 25327; Larry S. Nixon, 25640; Robert A. Vanderhye, 27076; James T. Hosmer, 30184; Robert W. Farris, 31352; Richard G. Beshia, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mitchard, 29009; Duane M. Byers, 33563; Jeffrey H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr. 29368; Thomas E. Byrne, 32205; Mary J. Wilson, 32955; J. Scott Davidson, 33485; Alan M. Kagen, 36178; Robert A. Moian, 29834; B. J. Sadoff, 36663; James D. Berquist, 34776; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35329. I also authorize Nixon & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions directly communicated from the person, assignee, attorney, firm, or other organization sending instructions to Nixon & Vanderhye on behalf of the owner(s).

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FOR ADDITIONAL INVENTORS, check box ☒ and attach sheet with same information and signature and date for each.

RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Nixon & Vanderhye P.C. (12/95)

Page 2

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